ADVISORY COUNCIL FOR ADULT AND CONTINUING EDUCATION

ACE

REPORT

BASIC SCIENCE EDUCATION FOR ADULTS

The Advisory Council was established by the Secretary of State for Education and Science in October 1977 with the following remit:

To advise generally on matters relevant to the provision [illegible] England and Wales, and in

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BASIC SCIENCE EDUCATION FOR ADULTS

A report on the issues affecting the provision of adult general education in the sciences and technology

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"When you intend to call in a promiscuous multitude from the streets, and to treat them with a course of scientific instruction, you must do your utmost to make the heaven-born muse of Science leave for a time the clouds among which she is wont to recline in rapturous self-contemplation, casting now and then a look of pity and contempt on all below. You must absolutely induce her to come down to this nether world, to put on a clean apron, and enter a working family's dwelling, to ventilate it and make it wholesome and comfortable, to inspect the furniture and wardrobe, the kitchen utensils and the contents of the larder, nay actually to light the fire and cook a model meal, not forgetting the care of the young ones and of the sick person in the next room."

Thomas Twining, Vice-President of the Society of Arts, in *Science for the People:* A memorandum on various means for propagating scientific and practical knowledge among the working classes, and for thus promoting their physical, technical and social improvement; addressed to the Council of the Society of Arts, 1870.

"We want a just society and one which is characterised by intellectual honesty and a respect for individual freedom. But these virtues do not flourish in a society which is impoverished and we shall not advance the cause of individual freedom by turning our backs on scientific progress.

Scientists must broaden their perspectives and society must learn more about the scientist's work and about the relevance of scientific thought to everyday human concerns. What we must aim for is a scientifically literate society. I believe that scientific literacy is important not only for those who will pursue careers as professional scientists, or in engineering, industry and technology, but also for those whose talents lie in other fields. Both need the kind of insights provided by a broad understanding of the nature of scientific thought and of the contribution it can make to the creation of a well ordered and stable society."

Neil Macfarlane MP, Parliamentary Under-Secretary for Education and Science, speaking at the launching of the Association for Science Education project 'Science in Society', February 1981.

"It is not only that scientific facts are the key to understanding the technological world we live in. The processes of thought involved in establishing those facts, and in using them, and of experimentation, of the construction of hypotheses and the testing of evidence — are fostered by education in science. These are essential skills to be learned and mastered by all citizens in a country that has to earn its living by making things."

Baroness Young, Minister of State for Education and Science, speaking at a conference on science teacher education, June 1981.

CHAIRMAN'S PREFACE

Following the establishment of the Advisory Council, towards the end of 1977, a good deal of thought was necessarily given to the priorities for its first three year programme of work. There was no shortage of proposals and it was soon obvious that particularly difficult choices had to be made. One of the early contenders for attention was the overall imbalance in adult education provision between the sciences and the arts and physical education. Why has provision in the sciences always been dwarfed by the very much more flourishing programmes of arts subjects? And what could, or should, be done to help redress the balance?

It may be representative of a more general attitude among adult educators that some of the Council's members were not initially convinced that any of our inevitably limited resources should be invested in this kind of enquiry as an early priority. However, one member in particular, Allan Rogers, was convinced, and as a Welshman his arguments blended fervour and eloquence. The doubters were convinced and in April 1978 the Council set up a Committee on Science and Mathematics to:

- look at the place and provision of science and mathematics in adult education;
- investigate work that has been and is being done in this field;
- suggest possible lines of action and development.

The Council subsequently became engaged in a parallel study into adult basic mathematics * — in conjunction with the DES Committee of Inquiry into the Teaching of Mathematics in Schools — and the Committee therefore concentrated its attention on science. Since the more vocational aspects of the provision of science and technology in further and higher education are primarily intended for those seeking a thorough knowledge and competence in a particular scientific discipline, the Committee focussed its attention on the provision of basic science and technology for adults.

The following report is the outcome of the Committee's work. To the relatively small number of adult educators working directly in this field, and working hard and successfully, we hope this report will give encouragement; to everyone else in the adult education world, we hope the following pages will make the case for develop-

* The results of this study are to be published by the Advisory Council early in 1982 in its report on *Adults' Mathematical Ability and Performance.*

ing this area of provision and suggest ways of promoting science courses as a significant part of adult general education provision.

All of us in an increasingly technological society need to make sense of the sciences and technology as they affect our lives: adult education has the job of helping us to do so. This is an important responsibility and the Council hopes that the report will help more adult educators to comprehend and meet that responsibility. The report makes the case for the provision of basic science education for adults: I will only preface that by noting that the effects of the sciences on human life and thought are now too substantial and pervasive to be ignored, and basic education in the sciences and technology must have a significant place in any balanced system of liberal education for adults.

The Committee deliberated long over using the word 'basic' to describe the area being considered. What was wanted was a word to signify that level of non-examinable science education which requires no background knowledge but which is by no means remedial: and 'basic' has acquired, some would say unfortunately, those remedial overtones in the phrase adult basic education. 'General' science education was considered, but this could introduce some confusion with its school usage and with the Council's already stated preference for 'general' in place of 'non-vocational'. Thus, with no better alternative available, 'basic' is used in this report in its proper dictionary meaning and in the educational sense of that stage of learning which is fundamental to the subsequent acquisition of a much wider understanding and competency in any subject or skill.

I hope that what we have to say in this report and its conclusions will not be dismissed by those who nowadays feel an understandable repugnance for *some* of the actual and potential effects of the latest scientific discoveries. Indeed that is all the more reason for seeking to raise the level of scientific and technological awareness among the general public. We live at a time when more and more complex decisions have to be made which greatly affect our everyday lives. Consequently we need a balanced adult education programme to help us towards more informed views of the national issues and industrial, commercial and social developments taking place around us.

The Council's thanks are due to the Committee, especially to its co-opted members, whose work made this report possible, and to its two convenors, Allan Rogers, until his election to the European Parliament, and his successor, Richard Freeman. The work of the

Committee was serviced by the Council's Secretariat, and much of the information gathering and report drafting was undertaken by the Council's Assistant Secretary, Martin Warburton. The Council gratefully acknowledges the effective way in which all of the Committee's work was carried out.

RICHARD HOGGART
Chairman of Council

October 1981

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I INTRODUCTION

1 The Advisory Council's discussion paper on *Science Education for Adults*, published in May 1980, examined the need, place and provision of basic, or 'non-specialist', science and technology education for adults. It concluded not unexpectedly, that its examination had found more problems than solutions; and that adult education providers were not well equipped, either in manpower or physical resources, to tackle those problems. The discussion paper prompted a range of responses from the adversely critical to the warmly sympathetic. Some of the respondents were consulted further and visits were made to providing bodies for first-hand enquiries into their basic science programmes. The respondents and the visits made are listed on page 42. This report takes account of that additional evidence and the Council is grateful to all those who gave their time to provide it.

2 In deciding to confine the enquiry to basic science education the Council excluded examination-based and up-dating courses. Basic science education in the context of this report is therefore taken to include, where appropriate, basic technological education, and to mean part-time 'non-vocational' education in the sciences, although the Council would prefer to replace the conventional and negative term 'non-vocational' by 'general'. The word 'basic' is used here, as in the Advisory Council's report on *A Strategy for the Basic Education of Adults*, to relate to "the starting points on a road that is potentially without end". Thus basic science education signifies the acquisition of the fundamental knowledge and skills required to proceed confidently into a wider and deeper understanding of any or all of the sciences. The report concentrates on this basic provision because the Council is convinced that the adult population must have sufficient scientific knowledge and appreciation to understand and to contribute to an increasingly technological society, which must become scientifically and technologically 'literate'. Large numbers of adults do of course enrol in GCE O level science courses in colleges of further education.[1] This partly reflects adult students' needs for examination qualifications to advance their careers; it might also suggest that general or non-examinable courses are either not available in their locality or not suited to their needs.

1 See pages 39 to 41 for notes and references.

3 The 'sciences', like the 'arts', cannot be regarded simply as a single discipline. In making educational provision for the sciences there must be wide differences in what is needed to teach and study Astronomy and what is needed to teach and study Zoology. However this report explores the ground common to all the sciences in the sense of the very limited provision of adult courses, the reasons for that state of affairs, and the possible ways of changing it.

II THE CASE FOR THE SCIENCES AND TECHNOLOGY IN THE EDUCATION OF ADULTS

4 It should not be necessary nowadays to consider whether the sciences and technology merit a place in a balanced liberal education. The effects of the sciences and associated technologies on human life and thought have become so great, and are potentially so much greater, that those who have no understanding of them and of the sciences which produced them, cannot be considered sufficiently educated to take part fully in the life of their time. The sciences and their application should be recognised and taught as major human activities which explore the realm of human experience. There is a duty to present the sciences and their application as part of our cultural heritage to be taught in harmony with, not in opposition to, the various arts subjects which alone have so far been regarded as the humanities.

5 The world we live in has been transformed socially and often physically by the application of the sciences in modern technology. Whether for good or ill, society today is circumscribed by the results of scientific thought. Thus, one of the aims of a balanced educational system for everyone should be to provide a knowledge of the sciences, of scientific method, and of the language of science as well as a general idea of the scope of their application in contemporary technological achievements. As a recent article put it:

> "For many, it seems self-evident that, in a post-industrial, democratically-orientated society, in a world facing acute problems, many of them science-related, every citizen needs to have some knowledge and understanding of science and technology, some appreciation of their social and historical relations and some experience and appreciation of scientific method and its applicability."[2]

6 Scientists and technologists have an important contribution to make in modern society. But the aim of education is not simply to train scientific specialists—or indeed specialists in anything else. This is particularly true in the education of adults. The educational system already provides for those wishing to specialise in scientific or technological fields. The provision of facilities for the general public to acquire some basic scientific background is equally important. At the same time a proper place must be assigned to the arts and the humanities in the education of science specialists.

7 'Science' is a part of the normal secondary school curriculum, although the opportunities for study may in fact be severely restricted when pupils select their 'options' for formal examination purposes; there are particular factors affecting the choice of science subjects by girls, and the low uptake of the physical sciences in schools is a long standing problem.[3] Early in 1980 the Department of Education and Science published a consultative paper on the school curriculum calling for at least ten per cent of school time in the period of compulsory education to be devoted to science subjects or closely related work.[1] However the Department's more recent paper on the school curriculum does not suggest the amount of time to be spent studying science in secondary schools; only that pupils should:

> ". . . continue with some work in the three main sciences in the fourth and fifth years, and there are those who argue that for all pupils, including the less able, a scientific education requires a programme of breadth."

The shortages of teachers and laboratories and the relative absence of girls in the physical sciences are identified as problems which the Department is to consider further before publishing its conclusions.[6] The Minister of State for Education and Science has recently announced that the Government plans to publish, before the end of 1981, a consultative paper on the teaching of science in schools.[0] It is also reported that the Department of Education and Science is to fund a five-year £½ million review of the school science curriculum to be undertaken by the Schools Council in association with teachers in membership of the Association for Science Education.[7]

8 Consideration of the sciences in the education of adults by comparison is very much neglected. This report seeks in some measure to redress that balance by concentrating on the ways in which basic science can be made more available to more adults, rather than examining whether or not the sciences should form part of a balanced adult education system. In effect the report starts from the position expressed by Neil Macfarlane in his recent remarks to the Chemical Society that:

> "The Government attach great importance to the support of basic science, in which the United Kingdom excels, as an investment in the country's industrial and intellectual future."[8]

and relates that "great importance" to the field of adult general education.

9 On the assumption that the local education authorities and the Responsible Bodies[9] have the facilities and the resources to provide study opportunities in the sciences for adults (this

assumption may be questioned — see chapter IV), and that adults want this form of study[10] (see paragraphs 17 and 20), the case for the sciences in adult general education is made. But more research is needed into why people attend courses in the sciences and what they obtain from them, and why people reject other courses or abandon study in mid-course.

10 Some may argue that the sciences are conceptually difficult subject areas, but it is as important to teach the sciences *per se* (since most adult students enrol because of an interest in a particular subject), as to teach adults a general 'appreciation' of the sciences (see paragraph 41). As one respondent to the discussion paper wrote:

> "It is the scientific outlook, not a multiplicity of scientific experiences, that is to be achieved."

There must therefore be opportunities for adults to return to a study of the sciences as a single discipline or set of disciplines, *and* to learn about the sciences as they affect contemporary life.

III CURRENT FORMAL AND NON-FORMAL PROVISION

11 It is difficult to measure the amount of non-formal provision in the sciences for adults. Interest in the sciences and technology through broadcasting, periodicals, libraries and museums is very considerable, and almost impossible to quantify. Certainly these non-formal sources make an enormously valuable contribution to a general knowledge of the sciences and technology. Many flourishing clubs and societies are based on the sciences, particularly natural history. A recent enquiry for the Advisory Council showed the remarkable number and range of interests of local clubs and societies.[11] Their non-formal educational influence should not be underestimated.

COURSE PROVISION

12 There are considerable differences in the scale and type of formal provision made by the local education authorities, the Responsible Bodies and the Open University. Each of these providers is therefore considered separately.

Local Education Authorities

13 There are no detailed published statistics of adult education courses in England and Wales, but there are some indicators of the level of provision of adult courses in the sciences. An examination of the prospectuses of adult education centres and further education colleges in a number of local education authorities suggests that on average no more than about ten per cent of part-time student contact hours are devoted to the sciences; mainly the provision of GCE O level science subjects. This figure accords with unpublished figures from the Department of Education and Science, based on a pilot statistical exercise carried out in 1978–79, which show that, in the adult education centres of 84 local education authorities, mathematics and science courses accounted for only two per cent of all courses (see Table 1); and again some of these science and mathematics courses were identified as leading to an examination.[12]

TABLE 1

Adult Education Centres: Percentage of Courses in each of the Main Subject Areas 1978–79

Physical education and dance	25
Needlecrafts	18
Visual arts and ceramics	14
Foreign language and literature	8
Food subjects and cookery	6
Music, drama and speech	5
Wood, metal and building crafts	4
Humanities, English and Welsh	4
Office skills	4
Technical subjects	3
English as a second language [a]	2
Mathematics and science [a]	2
Social studies and voluntary service	1
Education theory and development	1
Medical and health subjects	1
Other subjects [b]	2

Notes: (a) Excluding basic literacy and numeracy

(b) Including card and board games, gardening, driving, animal care and training

Source: DES unpublished statistics

In those local education authorities where adult education is organised through specialised adult education centres and/or schools, the further education colleges' contribution to the sciences for adults is likely to be mostly GCE O level subjects, and the few initiatives in the provision of basic science are often left by the colleges to the adult education service. However, where adult education provision is based in further education colleges, there is evidence of basic science and technology courses being offered, consistent with the colleges taking an active rôle in the general education of adults.[13] A very few local authorities have adult education colleges with purpose built science facilities and specialist staff; here provision of basic science courses for adults is likely to be at its greatest.

14 Basic courses in the sciences provided by adult education centres and further education colleges can be divided between: the 'direct type', as in such courses as 'Introduction to Science', 'Botany for Beginners', 'Science and Society', 'Return to Study in Science', awareness courses for new technologies, science units in the Open College and modules from science degree courses; and the 'indirect type' where the scientific content is not immediately apparent to the students or is only a part of the course, as in courses on 'New Opportunities' or in health education and on environmental issues such as energy and pollution.

15 Polytechnics and Institutes of Higher Education are comparative newcomers to adult general education provision. A few of these institutions are planning to offer part-time basic courses in the sciences, but they have as yet no significant quantity of provision.

University Extra-Mural Departments

16 Figures from the university adult education departments in membership of the Universities Council for Adult Education show that in 1978–79 thirty-nine universities provided 10,707 courses, of which 1,536 (14.3 per cent) were in the sciences including mathematics. Table 2 shows the courses divided into subject areas (DES categories), and Table 3 gives the comparative percentage for the sciences and mathematics for the years 1974–75 to 1979–80;[14] the figures include joint extra-mural/Workers' Educational Association courses.

TABLE 2

Universities Adult Education Science Provision 1978–79

Subject (DES categories)	*Percentage of all courses offered*
Physical sciences	6.4
Biological sciences	6.8
Other science subjects, including mathematics and computing	1.1
Total	14.3

Source: UCAE Annual Report 1978–79

TABLE 3

Universities Adult Education Science Provision 1974–75 to 1979–80

	Percentage of all courses offered
1974–75	16.1
1975–76	16.2
1976–77	14.8
1977–78	14.2
1978–79	14.3
1979–80	14.9

Source: UCAE Annual Reports 1974–75 to 1979–80

17 The UCAE statistics for extra-mural provision do not distinguish between either specialist or continuing education courses and basic courses in the sciences; any analysis should therefore be treated with some caution. Nevertheless university extra-mural provision in the sciences can be described as patchy with some universities having a sizeable extra-mural programme in the sciences, as much as 24 per cent of all courses offered in one department in 1978–79, whilst others provide very little. The fact that some departments have consistently provided a relatively high proportion of courses in the sciences, suggests that there is a public demand to be met. The *UCAE Annual Report* for 1979–80 includes for the first time figures for continuing education courses provided by university departments other than extra-mural departments, but these are not broken down by subject. Examination of extra-mural department prospectuses shows that their courses in the sciences range from single lectures through tutorial and sessional classes to 'extension' courses and, in a few places, to university certificates and diplomas.

Workers' Educational Association

18 The Workers' Educational Association provided a total of 9,780 courses in 1978–79, of which 11.8 per cent were in the sciences with geology and the biological sciences as the largest areas of provision (see Table 4); these figures probably include joint WEA/university extra-mural courses, but their source does not indicate this. Comparative percentages for the sciences and mathematics for the years 1974–75 to 1979–80 are given in Table 5.[15]

TABLE 4

Workers' Educational Association Science Provision 1978–79

Subject (DES categories)	*Percentage of all courses offered*	
Physics	0.1	
Astronomy	0.7	
Geology	1.8	
Other physical sciences	0.7	
		3.3
Botany	2.5	
Zoology	2.1	
Other biological sciences	3.5	
		8.1
Other scientific studies, including maths		0.4
	Total	11.8

Source: WEA Biennial Report 1979–81

TABLE 5

Workers' Educational Association Science Provision 1974–75 to 1979–80

	Percentage of all courses offered
1974–75	13.7
1975–76	13.5
1976–77	12.7
1977–78	12.0
1978–79	11.8
1979–80	12.5

Source: WEA Biennial Reports 1975–77 to 1979–81

19 Most of the WEA's courses in the sciences can be classified as basic, although science is also included in their day release 'Health and Safety at Work' courses under the TUC regional educational scheme, which accounted for 14 per cent of the

WEA's total programme in 1978–79. This percentage has since decreased due to the present economic recession.

20 Where specialist science tutors are appointed there appears to be, not surprisingly, an expansion of provision in the sciences. In 1963 the Northern District of the WEA appointed a tutor organiser in science and the District's provision in the sciences increased from 10 to 20 per cent of its programme over a period of five years. Similarly, in one university extra-mural department over the period 1978 to 1980, a trebling of the number of full-time staff committed to the sciences (from one to three) led to a six-fold increase in the number of science courses taken up. This department's provision in the sciences has increased over this period from 1 per cent to about 7 per cent of its total programme.

Distance Learning

21 With the obvious exception of its undergraduate level science courses (which can also be taken by associate students) the Open University's contribution to studies in basic science is necessarily limited to its Community Education programme of short courses. The University's *Prospectus for 1981–82* reports that "Community Education is one of the fastest growing areas in the Open University". Out of ten courses currently on offer, only 'Energy in the Home' can be classified among the sciences and technology. The course on 'Water Conservation' had some scientific content, as does the course on 'Industrial Archaeology' but the former, after running for three years and receiving favourable comments from students when piloted, is no longer offered as a Community Education course. Unpublished data shows that 'Energy in the Home' attracted a total of 1,700 students for its first two offerings in 1978–79. A further 2,000 students have enrolled for the course in 1979–80 and 1980–81. Analysis of the students enrolled for the first two courses shows that three-quarters were men, over one-third had completed their full-time education at or before 16 years of age, about one-third had no examination qualifications above GCE O level, and barely one-third could be considered as having scientific or technological occupations. While technological updating at post-experience level is a high priority, the Open University currently has no plans to increase the number of basic science and technology courses in its Community Education programme where there is likely to be more emphasis on

'social concern' courses rather than opportunities to study about environmental issues or new technologies.

22 Examination of a number of correspondence college prospectuses reveals very little in basic science, although all offer GCE O level courses in science subjects. 'Astronomy' is offered by one college as a 'leisure course' and 'The Green Earth: An Ecology Workbook' (linked with the television series 'Botanic Man') is offered by another. These few courses are of course only a tiny fraction of the total correspondence college provision and, though welcome, they can scarcely be claimed to contribute significantly to the overall provision in basic science.

MEDIA PROVISION

23 There appear to be no detailed studies of the total 'picture' of the sciences presented through broadcasting. Some study of this kind could be useful, although it would be costly to achieve a fully comprehensive study of all that is being provided.

24 There is certainly a widespread general interest in science broadcasts as indicated by the BBC figures for 1978 average weekly programme audiences:

'Science Now'	(Radio)	200,000
'Horizon'	(Television)	1,750,000
'World About Us'	(Television)	1,850,000
'Tomorrow's World'	(Television)	7,150,000

Whilst such figures almost certainly include a majority of people who simply enjoy watching or listening in a casual way and are by no means willing to commit themselves to formal study, they do suggest that the potential adult education demand is greater than is generally supposed. The audience figures for 'Tomorrow's World', like the others quoted, may be inflated by the expectation of a more popular preceding or following programme. If this is so, then careful juxtapositioning of programmes in the sciences and technology with popular programmes would increase science programme audiences. The popularity of 'Tomorrow's World' may also be due to its technological or applied scientific, rather than pure scientific, content. Whatever the reasons for its popularity, its 1978 weekly audience figure was almost three times the total adult education student enrolment figure for England and Wales of about 2½ million in 1978–79.[16] With more emphasis on open learning systems and the complementary use of broadcasting,

these audience figures could offer considerable potential for adult basic science education.

25 There is a very wide range of radio and television programmes over time covering all aspects of the sciences at various levels — from popular items in the News, 'Nationwide' and 'Blue Peter' to serious series such as 'Life on Earth', 'Botanic Man', 'The Silicon Factor', and 'Horizon'. The target audience for programmes can be categorised in various ways, for example, for children or for adults generally, for schools or adults learning at home, and for the Open University. Many are at a high level of sophistication and are accompanied by books (and locally organised courses), whilst others are less serious and attract audiences of many millions. Very little information is available about the audiences for, or the effects of, these programmes, except for the Open University and to some extent schools broadcasting. But there is every reason to suppose that broadcasting is making a sizeable contribution, both educationally and educatively,[17] to increasing the level of public awareness of the sciences.

26 The BBC Audience Research Department has reported a number of investigations on science programmes, such as: *What 'The Ascent of Man' conveyed to its Viewers; What do you know about Cuckoos? — a pre-broadcast study; What 'The Changing Face of Medicine' conveyed to its Viewers; The Effect of 'Is it Cancer, Doctor?'*. Few positive conclusions can be reached from these studies except that it is probably those who are already well informed who most regularly watch and listen to 'general' science output. The reports regularly indicate just how difficult it is to research this sort of subject.

27 Evidence drawn from information on the sale of books accompanying broadcast science programmes can be misleading, but the book accompanying the prestige series on 'The Ascent of Man' was a really big seller — over 400,000 copies (hardback and paperback), whilst a book related to a further education science programme series might be expected to sell between 5,000 and 25,000 copies.

28 There are a few periodicals catering for specific vocational scientific interests, and a much larger number catering for hobbies with a scientific or technological basis. Audited sales figures for newspapers and magazines clearly demonstrate the existing magnitude of this non-formal provision, and at the same time emphasise the importance of periodicals as potential and actual purveyors of scientific and technological education.

LIBRARIES AND MUSEUMS

29 The public library system cannot provide any real assessment of the amount of public interest in either specialist or non-specialist books on the sciences or of the proportion of library stock devoted to science texts. Some volumes are too technical and too limited in interest to be purchased for general circulation and books not available in main libraries can always be obtained from the British Library Lending Division. The high cost of science books can also limit their availability — the Price Commission reported to Parliament in June 1978 that the average price of books in science and technology had increased by between 300 and 400 per cent since 1970. It need hardly be added that in the present economic climate the book purchasing funds available to libraries are continually diminishing.

30 In their efforts to assist in adult literacy work many public libraries have tried to provide basic expository materials in the sciences, only to find that very little has been published. This may now be changing as publishers begin to respond to the emerging 'literacy' demand.

31 Museums contribute to education in the sciences through their national and local networks, and they are potentially important partners for the providers of formal science study opportunities for adults.

32 The national museums attracted 22 million visitors in 1978, a growth of 26 per cent since 1975, although this figure undoubtedly includes a great many seasonal visitors from abroad. Interestingly the Science Museum attracted more visitors than any other, except the British Museum, and has achieved a 45 per cent increase in visitors since 1975. In 1978 visitors to the museums with dominant science interests (Science, Geological, Natural History, Zoological) comprised 33 per cent of the total number of visitors to national museums. The opportunities offered by this source of public education in the sciences are considerable, through the organisation of public lectures, purchase of scientific and technical objects, temporary exhibitions of topical material and the publication of supplementary educational materials for the general public.

33 Apart from grants-in-aid from central government to individual national museums, and specific allocations for scientific purchase, there is a Fund for the Preservation of Technological and Scientific Material. The Fund's administrative arrangements are currently under review, but it is at present administered by

the Science Museum, and its purpose is, and is likely to remain, the boosting of local collections through help in purchasing scientific, technological and natural history objects or groups of closely related objects.

34 Local museums, financed by local authorities, local industries and private societies and trusts, are numerous. There are many volunteers assisting in scientific and technological preservation work for museums, private societies and trusts — in itself a process of non-formal adult education in the sciences. Those museums which display the progress of local industrial and technical developments or have specific science and technology collections are important resources on which adult educators can draw. Too often these museum resources are neglected or underused by those who could use them as venues for classes and as a local source of artefacts and a bank of technical expertise. One-day and short residential courses have been successfully based on museums, and museum staff are often willing to organise and teach adult courses in the sciences; courses of this kind have been run under the auspices of local adult education centres.

35 We all need to be prepared to cope with scientific change and it is desirable that parents should not lag behind their children in an appreciation of the rapidly changing world. The museums are one of the few institutions which cater educationally for adults and children together, and those who help museum visitors to make the best use of their visits are providing a valuable service.

IV REASONS FOR THE PRESENT STATE OF PROVISION

36 Since there is no organised or co-ordinated development of the sciences in adult education, it is not surprising that it is not easy to map the existing provision of basic science and technology courses for adults. Nevertheless the situation sketched in the preceding chapter shows clearly enough that the present level of provision is low. This chapter examines some of the reasons for that condition.

LEGACY OF SCHOOL

37 If it is fair to say that the sciences are not held in high regard by either the generality of students or tutors in adult education, it may be that this attitude is at least partly acquired at school, where the inadequate provision of the sciences has been noted in a number of comparatively recent documents. The journal *Education* reports that:

> ". . . many teachers discontinued any form of science education at the age of 14. With such a limited background these general subject teachers, though wishing to introduce simple scientific ideas to their pupils, feel inadequate, lack confidence and generally do not embark upon any scientific investigations . . . As an uneasy compromise some take their pupils on nature walks . . ."[18]

This comment was reiterated by HM Inspectors in *Primary Education in England* where they noted that:

> "The most severe obstacle to the improvement of science in the primary school is that many existing teachers lack a working knowledge of elementary science appropriate to children of this age."[19]

The Schools Council has noted that "For some pupils the effective choice between science and non-science subjects in the sixth form was made at the age of 13 and 14",[20] and reference has already been made (in paragraph 7) to more recent comments by HM Inspectorate on girls and science and to the comments on secondary school science in the DES publication *The School Curriculum* and its predecessor *A Framework for the School Curriculum.* The Association for Science Education also asserts that a negative attitude to the sciences begins at school:

> "A lack of opportunity to explore the history and philosophy of science and to study science in its social, economic and political contexts is perhaps a major contributory factor to the popular image

of science gained by young people. What they see is a subject dominated by facts and principles established outside their experience of everyday life. They study a subject isolated from its history or context and which is also very demanding, time-consuming and complex. This image results in part from the failure to locate science studies in the everyday context of life and work, and in part from the failure to integrate science into the common culture. The majority of young people fail to de-mystify the subject and do not see science for what it is — one of the most important *cultural* activities devised by man." [21]

38 Nevertheless there are encouraging developments in the schools which are helping to improve the status of the sciences. Comments on science in the recent DES publication on the school curriculum have been followed by the recent announcement of a review of the science curriculum in schools (see paragraph 7). The British Association of Young Scientists, the Science and Technology Regional Organisations, the Association for Science Education, and lectures arranged by the Royal Institution and other bodies to popularise science, all help towards improving the quality of teaching in schools, enhancing the status and increasing the public awareness of the sciences and technology.

39 The increased status of the sciences must stem in part from changes in the schools. Adult and continuing education cannot alone deal with the whole problem. The Association for Science Education has commented that:

"We have done little to relate science studies (in schools) to other legitimate goals, particularly those related to education for life, for work, for citizenship or for leisure." [22]

The Department's recent initiatives concerning school science are to be welcomed in the expectation that this recognition of the approaches to, and the importance of, the sciences in schools (and therefore to industry and commerce) will eventually encourage an increase in the overall demand for, and provision of, basic science courses for adults. In its recent policy statement *Education Through Science* the Association for Science Education believes that greater resources should be allocated to science related courses in adult education:

"The Association notes that a strong case exists for a more systematic and imaginative approach to continuing education through science in the context of adult and recurrent education. Implicit in many of our recommendations for curriculum reform at the school level is the notion that science occupies an important place in our culture. The Association believes that many of the aims for science education presented earlier in this statement are equally relevant to courses designed for adult learners. The Association resists the notion that

science education is essentially an activity that is completed for many individuals at the point at which they leave school. School programmes, however organised, can do no more than introduce young people to certain selected aspects of science and technology, and whilst many students will continue their studies in further and higher education, the majority will not. Although Adult Education Centres and Extra-Mural Departments do include in their programmes some opportunities for science-based studies, the Association believes that greater resources should be allocated to science-related courses in adult education and the development of appropriate expertise to resolve some of the problems we have presented."[23]

THE IMAGE OF SCIENCE

40 'Science' is often presented as esoteric, remote and beyond the reach of most adults. It is also often portrayed as 'objective' and not connected with being human and therefore to be rejected by people concerned with human feelings and values. 'Science', after a period of being able to perform miracles, is now frequently seen as the cause of our troubles — pollution, nuclear weapons, thalidomide. Many people feel that there has in the last few years been a drift away from rational thought (including science) towards numerous 'whatever I feel *is*' movements, towards rejecting the need for evidence in arguments, and at the extreme, towards force being the principal way of conducting human affairs. This is a dangerous drift in any society, but it has gone largely unopposed and unmentioned. Perhaps the general disillusionment with 'science' (and, by association, with facts and logical argument) has conditioned us to be less willing to oppose the extremes of the rejection of 'science'.

41 Basic courses in the sciences should be concerned with an appreciation of scientific and technological issues as well as the acquisition of competence in any particular discipline. It may be that many people are discouraged by the sheer volume of basic work and technical jargon to be understood before any measure of competence can be achieved. If so, this is surely a hangover from their school science education where the foundations are laid for eventual mastery of a subject, determined, as one respondent to the discussion paper put it "by the requirements of higher education". Adult educators should be aiming to increase adults' awareness and understanding of scientific and technological issues rather than attempting to transmit a body of knowledge as the precursor to subject competence.

42 In addition the sciences are regarded by many as 'impersonal' subjects, in the sense that students are finding out about the unalterable physical laws of the universe which are difficult to comprehend and over which they have largely no control. More information is required on whether or not the difficulties associated with learning in the sciences are due in essence to this or to inappropriate teaching methods. There is however some evidence that drop-out rates from courses in the sciences are no higher than in other courses, which may suggest some consumer resistance to the courses offered in the sciences rather than inappropriate teaching methods.

43 Whilst the sciences in general are burdened with these images, they will occupy a tenuous corner of adult general education provision. Only when the study of the sciences begins to be seen as an indispensable means (equal amongst others) for all people to understand themselves and the world, and when they are viewed as being open to all, will they really begin to expand.

DIFFICULTIES IN PROVIDING COURSES

44 Concern about the low level of scientific understanding in the population has been expressed in a succession of earlier reports all grappling with the same perennial and intractable problem.[24] These reports have invariably included three elements: first, they have argued the social or intellectual importance of the sciences and urged additional effort; second, they have drawn attention to this or that local achievement and implied that it should be more widely replicated; and third they have discussed teaching methods — vocabulary, teaching aids, laboratory facilities, field work and so on. There are providers who have taken note of each of these elements and have been successful in particular circumstances, but their work has not led to any extensive changes in the general picture of adult education programmes across the country. Adult education providers must continue to be innovative and aim for a more adequate balance in their provision for the sciences. It is not sufficient to stay only on the well mapped routes of the conventional adult education prospectuses.

45 The factors which appear to lead to successful basic courses in the sciences and technology need to be more widely understood. Some of the difficulties in providing these courses are considered below under the headings of marketing, staffing and facilities.

46 Consumer resistance to science and technology based courses and lectures emphasises the need for sound marketing techniques. To a large extent this can be related to staffing. Those university extra-mural departments which can call on the services of their own full-time science staff are among the largest providers of basic courses in the sciences, because these staff have time to assess the market and its need before organising and offering courses. This is much less true in the local education authority sector, where few full-time adult education staff have any personal background in the sciences; they may first of all therefore have to be persuaded to venture into this field. They and their part-time tutors are generally obliged to adopt a 'try it and see' approach in providing any sort of science programme. This offers little guarantee of success. They should therefore not be deterred by the lack of public response at the first or second attempt. Marketing requires good publicity directed at potential customers.[25] There are plenty of examples of 'off-putting' course titles. Where the course title contains the generic word 'science' or names one of the science disciplines then it must be qualified in some way. Any course description, however brief, needs to stress its suitability for 'beginners', and that no prior scientific knowledge is needed, or that where some knowledge of mathematics is required it is only at an elementary level. Exchange of information and experience amongst the major providers about marketing would be valuable.

47 Graduate teachers of science and technology are less numerous than their arts counterparts both in schools and adult education, and the shortage of adequately trained science and technology teachers at all levels is widely recognised. The problem is made worse in adult education by the difficulty in putting limits to the content of courses and in finding teachers capable of handling this wide ranging content. There is an overall shortage of qualified and experienced staff. Although some university extra-mural departments employ full-time staff with experience and expertise in the sciences, many extra-mural departments and most local education authorities employ very few full-time adult education staff trained in the sciences. From the evidence in paragraphs 13 to 20 it is difficult to avoid the conclusion that the size of the provision of basic science courses is directly related to the number of full-time adult education staff with a scientific background. However the local education authority sector has potentially the greatest source of supply of part-time teachers of the sciences — from secondary school teachers to further education college lecturers. In those

authorities where adult education is organised wholly or partly through further education colleges[13] it should be relatively easy to involve those colleges in courses for adults, if the provision of 'non-vocational' courses is seen as worthwhile and not inferior to 'vocational' education in terms of rates of pay, promotion prospects and so on. The Workers' Educational Association in their response to the discussion paper reported difficulties in recruiting suitable part-time tutors in the sciences, particularly to teach courses on the wider implications of the sciences. In keeping with the liberal education ideal, which embraces both the 'arts' and the 'sciences', the organisers of adult education courses must attempt to recruit staff with scientific backgrounds and provide them with appropriate support and training.

48 Many basic courses in the sciences need very little apparatus and equipment, which can usually be provided by the tutors, but adult students in the sciences and technology preferably need to have some access to practical apparatus as a necessary part of the testing, measuring and examining which is basic to most scientific and technological activity. Access to appropriate apparatus and equipment seems to be regarded by most providers as either presenting no real problem at all or, as with the Workers' Educational Association in its reliance on other peoples' premises, as a very big problem. Extra-mural departments and local education authorities have at their disposal apparatus and equipment from their own institutions, and with a more liberal policy of accessibility and use on the part of the authorities and the custodians of such apparatus, most difficulties can be overcome. Where adult education is organised through further education colleges access to apparatus and equipment should be relatively easy, given a clear college policy on the use of college facilities for all courses organised by the college. This applies particularly where the adult tutor is also the custodian of the college's facilities. However the necessary equipment can often be expensive or difficult to move, which can lead to science courses being restricted to universities and certain schools and colleges. It will always be easier to provide courses requiring little or no apparatus in the local village hall or community centre.

49 Staff in schools, colleges and universities are not always willing, suitable or qualified to teach adults. Alternative tutors, who may want to use the facilities offered by these institutions, have to be found. In these circumstances adult classes often find themselves constrained by the attitudes of day-time educa-

tors and administrators on how practical facilities shall be used, and which equipment and raw materials can or cannot be shared. These practical constraints form a barrier to access to education in the sciences. In addition, adult tutors need to be conversant with the use of individual laboratory equipment and briefed on the rules of the establishment.

50 It is of course possible to study the sciences 'practically' outside the laboratory. The Open University is a pioneer in the field of distance learning of practical science. Their experience suggests that whilst a measure of success is achieved with home experiment kits there are still practical and personal difficulties. Summer schools for the use of more expensive or complex equipment and the interchange of ideas are an essential part of the teaching of practical subjects by the Open University. The use of distance learning kits is worth further exploration for courses provided by other bodies. An examination of this approach, its practicability, effectiveness and cost, drawing on the experience of the Open University, would be helpful. Certainly any detailed proposals for an 'Open Tech' will have to consider the widest possible use of distance learning kits.[20]

V SOME WAYS FORWARD

51 The preceding chapter has outlined some of the ways in which the provision of basic courses in the sciences and technology could be improved; for example, by:

- more determined marketing with more staff time allocated to assessing and meeting identified interests and needs;
- appointing staff able to promote and teach such courses and providing appropriate staff support and training;
- drawing up a code of practice between the custodians and the users of scientific and technological apparatus and equipment.

The first two of these are amplified below before considering other ways in which the place and provision of courses in basic sciences and technology may be enhanced.

STIMULATING EXPANSION OF PROVISION

52 Apart from the short-lived concern with the science of everyday things and everyday life which developed in the secondary modern schools, school science education has followed a tradition established in the public and grammar schools: a tradition which treats science as a rigorous, highly technical professional activity governed by very strict rules about what constitutes science and scientific behaviour. This type of science education, determined by the demands of higher education, has deterred many pupils.[27] More recently attempts have been made to devise less narrowly defined curricula which seek to motivate and maintain the interest of the academically average and below average pupil. The science of everyday things and science through technology are being tried once again. However these changes, even if they receive widespread acceptance in the near future, will not affect the attitudes of the present adult population. There is no obvious simple mechanism to remove this legacy of antipathy and antagonism towards the sciences.

53 The university extra-mural departments' approach of appointing specialist subject staff to promote courses in specific subject areas shows that an increase in the number of full-time staff with a scientific background leads to an expansion of provision. This 'supply preceding demand' approach, exemplified by the

Open University and by adult literacy work, should however be coupled with the assessment of local interests and needs before the supply of appropriate educational responses. Where it is not possible to appoint full-time adult education staff qualified in the sciences, shared appointments could be considered when a full-time vacancy occurs elsewhere, for example in the further education college sector. This part-time commitment to adult education could then be increased over time as the number of courses to be organised grows. Part-time staff can be recruited from educational and other establishments, including industry and commerce, which might also be persuaded to sponsor courses or occasional lectures by visiting speakers. More tutors could be found among recently retired people with experience in the sciences.

54 Any expansion of adult general education in the sciences must receive help from those organisations which, for whatever reason, can encourage people back into education. Adult education bodies can provide an educational service to these 'customer' organisations — trades unions, women's organisations, the Health Education Council, local clubs and societies, which would decide the nature of, and the publicity for courses. The development of more interest in 'liberal' education, particularly in the basic sciences, should be a crucial part of any programme for the expansion of adult education in the sciences. Local organisers are best able to assess local needs and the likely success of a variety of approaches, including co-operation with other bodies. Even if student enrolments do not at first appear to justify the increased provision, and low numbers can often be expected initially, this does not deny the case for providing basic courses in the sciences and technology. Co-operation with other organisations should include those already engaged in basic education in the sciences. Co-operation between local education authority and Responsible Body providers, the Open University, the broadcasters, the British Association for the Advancement of Science, the Association for Science Education, the British Society for Social Responsibility in Science, the Science, Technology and Society Association, Science and Technology Regional Organisations, and industry and commerce could lead to a concentrated effort to increase provision through dissemination of information about successful courses, pooling of ideas, joint courses and so on.

55 The present emphasis on courses consisting of one evening meeting per week is unsuitable for many potential students.

Shift workers, many of whom have technological interests, are often unable to attend on the same evening for a number of weeks. The shorter working week will increase leisure time, particularly in the capital-intensive science based industries. Other formulae for the timing of courses should be more fully exploited, for example, one-day or half-day courses, weekend or short residential courses. Local organisers are again best placed to assess the timing and duration of local adult education offerings.

CURRICULUM INNOVATION

56 Adults' general scientific and technological awareness can be increased through:

(a) Courses which teach the sciences and technology *per se*. Here the aim is to impart an understanding of a particular part of science for whatever reason and through whatever vehicle. For this type of course the main problem is that the course tutors, be they university or further education lecturers, school teachers or scientists from industry, will have been taught science in the traditional way when they were children and young adults. Without strong external pressure or internal motivation to do otherwise, teachers at all levels frequently fall back on the methods by which they themselves were taught many years previously. The traditional ways of teaching the sciences, in their various historically defined disciplines, are not generally appropriate for adult education students. There are adult education tutors who, from personal flair and long experience, have devised acceptable content and efficient methods for teaching adults, but there are few opportunities and no formal mechanism for the dissemination of such successful curricula. Although there is a biennial conference of full-time university extra-mural science tutors, there are no real equivalents in adult education of the Association for Science Education, the Nuffield Foundation, the Schools Council, the teacher training institutions, the examining boards and DES and LEA in-service courses. It might be possible for the Association for Science Education (whose membership includes university and further education tutors) and the Nuffield Foundation to become more closely engaged in the dissemination of successful curricula and in the encouragement of the co-operative development of new ones in association with other bodies.

(b) Courses which teach *about* the sciences and technology. Here the aim is to describe the sciences as a human activity

in a variety of social contexts, and there are many opportunities for multi-disciplinary curricula. Ten years ago the possibility of such courses was remote because so few scientists thought of the sciences in this way and very little had been written about how science was perceived by its practitioners. This is now changing and there are non-technical books describing the sciences as a human activity which could form the basis for courses (see paragraph 62). Courses of this type are essential. Although it may not be necessary for ordinary citizens with no scientific training to understand the chemistry of the reaction of ozone with aerosol propellants in the upper atmosphere, they should be aware that the perceived social merit of a research finding and its attendant publicity can be related to the politics of the grant support system for scientific research.

(c) Courses to increase public awareness of scientific or technological issues, such as nuclear power generation, radioactive waste disposal, genetic engineering and microelectronics, together with courses about the political use and implications of these and other issues. The politicisation of scientific issues is increasing, but there is little guidance on how to approach and handle this aspect of adult education in science and technology.

It must be emphasised that courses can and do contain elements of all three of these general types. For example, type (c) courses could be used as the vehicle for type (a) materials.

57 Basic education in the sciences and technology could be achieved through diffusion within the whole provision of adult general education, as well as by more specialist study through the types of courses outlined in paragraph 56. For example, science is an important part of modern history. It becomes increasingly unrealistic to compartmentalise subjects as their base is affected by the changes to the structure of knowledge itself. These changes often mean that tutors must be offered regular up-dating training and that teaching aims and methods must be regularly and rigorously reviewed. To make adult education relevant to every individual student, teaching resources must be used as flexibly as possible, assisted by tutor support services and refresher training.

58 There are plenty of examples of this kind of diffusion, which already form the basis of adult education courses. Medical research is influencing physical education programmes, and adults should be aware of this scientific base as part of their education for living and choosing their own life styles. Changes

in the supply of certain raw materials affect their cost and hence the decisions parents may take in feeding and clothing their family. Our national economy is affected by geological prospecting in the North Sea, and our weather may be affected by the burning of fossil fuel. It is difficult to imagine that any programme in adult general education can escape some appreciation of the scientific and technological changes which are upon us.

59 It is not just a case of arguing for the dissemination of the knowledge and skills (in the use of statistics and the interpretation of figures in graphic form, for instance) needed to comprehend the critical ideas in many subjects, but also of urging that the prime task in both the humanities and the sciences is to help adults to make personal sense of their own world. All these factors argue for more interdisciplinary studies and more courses combining scientific instruction with some understanding of the relevance of the sciences in the world. Team teaching, well-developed in certain schools and underdeveloped in adult education, may be the most effective way of combining the talents of science and humanities tutors to present contemporary issues. Teaching the sciences through, or in combination with, another subject or topic could be a general recipe. It has, for example, been tried by introducing science into general interest courses which often include practical or fieldwork.

60 The curricular vehicle of 'science in a social context' works in a limited way, as do courses exploring the scientific content of current issues, by proceeding from the general to the particular. The 'indirect type' of basic course in the sciences, such as 'Return to Study' and 'New Opportunities' courses, which have a science component and where the organiser is in effect recruiting by subterfuge (see paragraph 14), can also be successful in increasing adults' scientific awareness.

LEARNING MATERIALS

61 There is no shortage of materials which can be used for basic adult education in the sciences, but tutors are not always aware of them since they are not necessarily labelled as specifically for adults. However there is still a need for materials, designed for adults, which fit part-time classes, not necessarily textbooks but loosely structured resource materials usable in many different ways: individually, in groups, in projects, sequentially

or selectively. The topics need to be relevant to adult interests and experience, putting the sciences in their proper setting where moral, political and social questions lie side by side with technical and theoretical expositions. Such materials also need to be designed at a variety of levels.

62 Some suggested sources of materials are:

- Television and radio programmes; increasing liaison generally between broadcasters and adult educators could lead to the use of 'live' or current programmes as the basis for discussion and further exploration as well as the use of recorded material, copyright regulations permitting.

- Published articles, for example, in the 'New Scientist' and 'Scientific American', including articles and pamphlets taking opposing views of an issue as, for instance, the nuclear power debate as seen by the Atomic Energy Authority and by the Friends of the Earth.

- Slides and films available commercially and from industry.

- Texts such as Open University publications, the recent 'Science in Society' books published in conjunction with the Association for Science Education and piloted successfully with an adult education class, publications from the Science in a Social Context (SISCON) project, the pack of materials on energy conservation recently produced jointly by the Department of Energy and the Adult Literacy and Basic Skills Unit. The Scottish Institute of Adult Education is also currently exploring the possibility of producing materials in the sciences suitable for adult literacy and numeracy work.

VI CONCLUSIONS

The Advisory Council draws the following conclusions from this report:

63 It would seem essential that **Central Government** should consider the establishment of a national development programme for basic science and technology education for adults. This programme could be undertaken through a single existing organisation or jointly through existing organisations either with an interest in basic science education or adult general education. A basic science and technology development programme might be funded jointly by, say, the Department of Education and Science, through its Science Branch, the Welsh Office and the Department of Industry. Although the initiative for setting up this programme should rest with central government, we acknowledge that it might be possible to finance it other than by central government funds. The development programme should:

(a) encourage the co-operation and participation of educational organisations in providing courses and in developing curricula and associated teaching methods;

(b) organise exchanges of information among providers about successful courses, marketing and publicity, audiences, teaching methods and curricula;

(c) facilitate links between providers and industrial and commercial organisations to discuss needs, course provision, sponsorship, etc;

(d) undertake or fund research into adults' basic science needs; the effectiveness of existing provision; science tutor training; the practicability, effectiveness and cost of distance learning kits; and other aspects of basic science provision as may become apparent;

(e) arrange for the collection of adequate statistics on adult science course provision.

64 In order to increase the quality and quantity of basic science and technology education for adults, **Providers** should consider:

(a) the recruitment of appropriate science staff, full-time as tutor-organisers and part-time as tutors, and the possibility of shared appointments between providers and between the different sectors of education;

(b) the potential adult tutors to be found among practising and recently retired staff from industry and commerce as well as from school, further and higher education;

(c) adequate support and training for adult science tutors;

(d) reductions in class contact hours and administrative responsibilities to enable full-time staff to assess and meet the scientific and technological interests and needs of the adults in their locality;

(e) effective arrangements for obtaining and using scientific apparatus and equipment for those adult science tutors with no direct access to equipment;

(f) the possibilities of much more varied timing of provision.

NOTES AND REFERENCES

1 (paragraph 2)
The Department of Education and Science does not publish statistics for the number of GCE candidates by age and subject for establishments of further education. However Table 21 'School Leavers CSE and GCE' in *Statistics of Education* Vol 2, 1978, gives 141,263 candidates in further education entered for GCE O level only. It seems reasonable to assume that a substantial proportion of these were adults and of that proportion between 30 and 40 per cent might be expected to have entered for science subjects.

2 (paragraph 5)
See the Digest 'Science in the Common Curriculum' in *Education* (5 June 1981).

3 (paragraph 7)
See *HMI Series: Matters for Discussion 13, Girls and Science* (HMSO 1980).

4 (paragraph 7)
See paragraph 24 of the consultative paper *A Framework for the School Curriculum* (DES 1980).

5 (paragraph 7)
See paragraph 47 of *The School Curriculum* (HMSO 1981).

6 (paragraph 7)
See DES Press Notice *Government to Seek Views on Science Teaching* (30 June 1981) which summarises the scope and contents of the Government's forthcoming consultative paper on the teaching of science in schools.

7 (paragraph 7)
See the *Times Higher Educational Supplement* (3 April 1981) and the *Guardian* (10 April 1981).

8 (paragraph 8)
See DES Press Notice *Science should be taught to all School Pupils* (9 April 1980) which summarises the Parliamentary Under-Secretary of State's address to the Annual Congress of The Chemical Society.

9 (paragraph 9)
The Responsible Bodies are largely the University Extra-Mural Departments and Workers' Educational Association Districts in England and Wales, which receive direct funding from the Department of Education and Science under regulation 28 of the Further Education Regulations 1975.

10 (paragraph 9)
In a national survey carried out for ACACE in 1980 (to be published in 1982) on a sample of the adult population, 12 per cent of respondents, when asked what subjects or personal interests they would like to learn about but had never previously done, replied by indicating a science or engineering course. This was more than for any other subject/interest category. Such a choice may be job-influenced but it indicates the scale of potential interest in these subject areas.

11 (paragraph 11)
See the report of an enquiry (to be published in 1982) conducted for ACACE by the University of Lancaster's Institute of Post-Compulsory Education; a localised survey in the Lancaster and Morecambe areas revealed a total of 285 clubs and societies, covering a wide range of interests.

12 (paragraph 13)
From unpublished DES statistics based on returns to Form 109A FE used for the first time in 1978–79.

13 (paragraphs 13 and 47)
A factual survey (unpublished) carried out by the ACACE Secretariat and periodically up-dated shows that at least 21 local education authorities organise their adult education provision exclusively through further education colleges and at least a further 23 organise their adult education provision through both further education colleges and specialised centres and/or schools.

14 (paragraph 16)
See the *Annual Reports* of the Universities Council for Adult Education.

15 (paragraph 18)
See the *Biennial Reports* of the National Executive Committee of the Workers' Educational Association.

16 (paragraph 24)
DES Statistical Bulletin 4/80 *Statistics of Further Education Students for 1978–79* gives 2,005,000 enrolments in LEA adult education and youth centres in England and Wales.
For England and Wales the 1979–81 *Biennial Report* of the National Executive Committee of WEA gives 163,898 enrolments for 1978–79 and the 1978–79 *Annual Report* of the Universities Council for Adult Education gives 196,764 enrolments, including joint extra-mural/WEA course enrolments. A total of 2,365,762 enrolments in England and Wales. This figure does not include enrolments for adult education courses in further education colleges for which no national figures are published.

17 (paragraph 25)
Broadcasters make a useful distinction between 'educational' and 'educative' programmes. Educational programmes are those which are planned from the beginning by education producers to convey a predetermined body of knowledge or skills, in which the broadcast element is often supported by specifically published materials and learning assessment arrangements. Educative programmes are those through which viewers and listeners may obtain new knowledge and skills but which are not planned and produced with any predetermined educational goals in mind. Foreign language courses are 'educational' programmes; 'Horizon' and 'Panorama' are 'educative' programmes.

18 (paragraph 37)
See the Digest 'Science 5 to 16' in *Education* (8 September 1980).

19 (paragraph 37)
See paragraph 5.83 in *Primary Education in England — A Survey by HM Inspectorate of Schools* (HMSO 1978).

20 (paragraph 37)
See Schools Council Working Paper 60 *Examinations at 18+*.

21 (paragraph 37)
See Part One of the Association for Science Education's consultative document *Alternatives for Science Education* (ASE 1979).

22 (paragraph 39)
Ibid page 52.

23 (paragraph 39)
See the Association for Science Education's policy statement *Education Through Science* (ASE 1981).

24 (paragraph 44)
See, for example, covering a short period only:

The Adult Education Committee of the Board of Education report No 8 *Natural Science in Adult Education* (1927);

Proceedings of the Sixth Annual Conference of the British Institute of Adult Education *Science and Adult Education* (1927);

WEA Executive Committee's Report (Central 198A) considering 'the possibilities of stimulating interest in the study of science on a non-vocational basis' (1932);

Report of the British Association for the Advancement of Science *Science Teaching in Adult Education* (1932).

25 (paragraph 46)
See Thomas, E. J. 'Advertising Post-Experience Courses in Science and Engineering'. *Adult Education* Vol 50 No 5. Although concerned with publicity methods for post-experience courses this article assesses the relative cost-benefit of various publicity methods.

26 (paragraph 50)
The Manpower Services Commission's consultative document *An 'Open Tech' Programme* (MSC 1981) refers to distance learning, but does not consider this in any detail.

27 (paragraph 52)
See ASE *Alternatives for Science Education* op cit, page 24.

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